Standard Operating Procedure

for

Routine Operation of the Rupprecht and Patashnick 8400N Ambient Particulate Nitrate Monitor in CRPAQS

DRAFT
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Table of Contents

1. Scope and Applicability

This operating procedure applies to the operation of the Rupprecht and Patashnick 8400N Ambient Particulate Nitrate Monitor, with software version 0.535, as installed by Aerosol Dynamics, Inc. The 8400N is a new instrument, and an operating manual has only recently become available. Since no manual was available at the time, this SOP serves as the primary operational document for the CRPAQS study.

2. Summary of Method

2.1 Method Parameters

- Measured parameter: Nitrate in airborne particles below 2.5 μm.
- Time resolution: Typically 10-min, user selectable between 3 min and 20 min.
- Detection Limit: 0.5 $\mu g/m^3$ for 10-min sample.
- Sample Flow: 1 L/min, with 5.5 L/min for precut
- Analytical Method: Particles are collected by humidification and impaction, and assayed in place by flash heating and chemiluminescent analysis of the evolved nitrogen oxide vapors.

2.2 Method Description

Ambient samples are pulled through a cyclone operated at 5.5 L/min to remove particles above 2.5 μm. From this, a 1 L/min portion of this flow is used for nitrate analysis. The 1 L/min nitrate sample flow passes through a carbon honeycomb denuder to remove potential gaseous interferences, and a Nafion humidifier to ensure that the particles are wet. Wetted, ambient particles are collected by impaction onto a nichrome strip mounted in a collection and vaporization cell. Typical sample period is 8.5 mins. After sample collection the system switches from this collection mode to the analysis mode. During the analysis step the sample flow bypasses the collection cell, while maintaining flow through the sample line, denuder and humidifier. The collection and vaporization cell is flushed with nitrogen gas, most of which is introduced at the side of the cell (called cross-flow), and a portion of which is introduced through the collection orifice (called orifice flow). The nitrogen flows through the cell and into a nitrogen oxide analyzer. The collection substrate is then flash heated by current from a battery until reaching an infrared cutoff. Typical heating times are 70-90 ms. Evolved nitrogen oxides are carried in the nitrogen flow to the analyzer, where they are reduced to NO by a molybdenum converter, and assayed by chemiluminescence. The analyzer output is integrated to yield the nitrate concentration. Additionally, the analyzer baseline is read prior to each analysis flash. At the end of the analysis period the system returns to sample collection. The cyclone precut, denuder, humidifier and collection-analysis cell are housed in a box, which is ventilated with outside air to try to maintain sampling temperatures close to ambient. The system outputs nitrate concentration and system operating parameters via a serial communications line at the end of each cycle.

The system may be setup to automatically conduct two types of audits: analyzer flow audits and analyzer span audits. Analyzer flow audits are done during the sample collection step, without interruption of the cycle. The analyzer flow audit value is used

to set the cross flow during the analysis step. Span audits take the system off-line for one or two cycles. Span audits may be done automatically at a preset time of day, at a frequency of one to seven days, as selected by the operator. Additionally, the system is calibrated manually using aqueous standards applied directly to the collection substrate.

The system is based on the integrated collection and vaporization cell developed by Stolzenburg and Hering (2000).

2.3 Data Quality Objectives

Data quality objectives were set at the outset of the study based on prior experience with the prototype system constructed by Aerosol Dynamics Inc., as reported by Stolzenburg and Hering (2000). These are:

- Accuracy: Daily average of 10 minute nitrate concentrations from the 8400N to agree within 25% of denuded nylon filter values from the sequential sampler at the same site.
- Precision: At least $\pm 10\%$ (= 1 sigma) as determined by replicate standards.
- Lower Quantifiable Limit: At least 10 ng, or 1μg/m3 for a 10 min sample.
- Completeness: At least 85% data completeness during designated intensive.

Quality assurance checks include (1) analysis of nitrate standards applied directly to the particle collection strip and (2) collection and analysis of filtered air samples to determine the dynamic blank and check for positive interferences. These are done at least monthly. Additionally, the NO_x analyzer span is checked automatically every second day.

3. Definitions

- CRPAQS: California Regional Particulate Air Quality Study
- ADI: Aerosol Dynamics, Inc.
- Pulse Generator: the main component of the 8400N (large box)
- Pulse Analyzer: the NO_x Analyzer component of the 8400N

4. Health and Safety Warnings

Gas cylinders (used for purge and calibration) must be properly secured, preferably with chain at top and bottom.

5. Cautions

- Do not turn on the Pulse Analyzer flow (i.e. connect to pump) without first connecting to the 25mm filter from the Pulse Generator.
- Test that N_2 cylinder and calibration gas cylinder are installed without leaks following procedure below under Section 11.3.2.

6. Interferences

There can be positive interference from adsorption of nitrogenous vapors not removed by the denuder. The extent of this interference is measured by the field blank described in Section 11.5.1.

7. Personnel Qualifications

The system requires a technically experienced operator who can understand the system, its operation and calibration.

8. Apparatus and Materials

- 8400N Pulse Generator
- 8400N Pulse Analyzer
- 8400N pump
- 5/16" OD aspirated sample line inside an insulated 3" ventilation line
- Ambient temperature probe with mounting clamp
- N_2 purge gas (grade 99.99% is sufficient), with CGA 580 regulator.
- 5 ppm NO in N_2 calibration gas with CGA 660 regulator
- 1/4" or 1/8" teflon line
- Distilled water
- Maintenance kit with:
  - Microliter syringe and aqueous calibration standards
  - In-line filter for blanks
  - Extra collection strips, washers and nuts
  - Spare denuder and analyzer filters
  - Software upload adapter
  - Forceps
  - Squirt bottle, watch glass, Q-tips, portable air

9. Site and Equipment Preparation

The sample line is 5/16" aluminum tubing housed inside a 3" aspirated duct, both of which should extend approximately 2 meters above the rooftop. There is an aluminum clamp to hold the tubing within the screened inlet hat. Make sure you have an inlet hat that is not painted.

Install the Pulse Generator and Pulse Analyzer per instructions in Appendix A: Quick Start Guide. The Pulse Analyzer can be placed either alongside or underneath the Pulse Generator provided it is within 24 inches of the outlet located at the left hand bottom of the main unit. If located underneath, it is best to construct a separate shelf so that the Pulse Analyzer can be removed easily without disturbing the Pulse Generator. Ensure that the analyzer filter is in place prior to starting the flow to the Pulse Analyzer. Insulate the indoor portion of the 3" aspirated duct with flexible insulation such as Reflectix or fiberglass.

The RS-232 port on the 8400N should be connected to the site data acquisition system with the supplied serial cable. See Section 16.1 for more details.

Prior to routine operation:

- Leak test cell and inlet per instructions in Quick Start Guide. Drift should be <0.01atm/1min
- Verify system and cycle parameters settings against the list in Table 1: System Parameters and Settings.
- Perform analyzer audit per instructions under Section 11.4.7.3.
- Startup system and check readings per Section 11.4.
- Run aqueous standards within first few days of operation per Section 11.5.3.

10. Instrument Calibration

The NO_x monitor is automatically spanned every second day using a 5 ppm calibration gas from Scott-Marrin. The time of day is selected in the cycle setup window. The span is manually reset when it differs from the nominal concentration by $\pm 10\%$. The complete system is calibrated with aqueous standards applied directly to the collection substrate every second week. Field blanks are measured every second week by placing a Teflon filter between the cyclone and the denuder. The aqueous standards and field blanks must be done manually, following the procedures described in Section 11.5.

11. Instrument Operation

11.1. General Operation

Turn on power to both the Pulse Generator and Pulse Analyzer. Approximately 30 minutes are required for the ozone generator in the Pulse Analyzer to begin operating. Confirm all system parameters are set as per Table 1: System Parameters and Settings. Pressing "RUN/STOP" will begin sampling and analysis. The 8400N is designed for automated operation and will continue sampling and analysis indefinitely barring further operator intervention or malfunction.

The site operator should check the instrument and complete the maintenance log sheets (see Appendix B) at least twice weekly as described in Section 11.

Pressing RUN/STOP again will halt sampling (with an option to abort immediately or finish the current ten minute cycle). Power can then be turned off to both the Pulse Generator and Pulse Analyzer.

See Appendix A: Quick Start Guide for details.

11.2. Schedule of Operational Tasks

11.2.1. Daily Checks

- Check N_2 and Cal cylinder pressures
- Refill water reservoir (grocery store distilled water OK)
- Check "R-Cell" pressure on NO_x analyzer
- Check indicated sample flow rate during sample step
- Check flash time and flash strip

- Check manual rotameter flow indications and vacuum gauge readings
- Record analyzer audit data
- Run analyzer audit if not on auto-audit (2-3 times weekly)
- Check that 8400N Pulse Generator is running without error flags indicated

11.2.2. Semi-Monthly Tasks

- Replace N_2 cylinder whenever low
- Measure field blank
- Clean cyclone
- Calibrate with aqueous standards

11.2.3. Monthly Tasks (Every 4-6 Weeks)

- Clean cell orifice
- Replace flash strip
- Replace makeup flow filter if makeup flow dropping
- Leak check system

11.3. Consumables

11.3.1. Consumable Items

The 8400N uses either industrial or Grade 4.8 nitrogen carrier gas. Normal consumption is 1 STP cubic foot per day. A 230 cu foot (size K or 1A) cylinder should last about 3 weeks and cost $30-$50. "Ultra-pure" N_2 can be used, but is generally more expensive.

11.3.2. Changing the N_2 Cylinder

When the N_2 cylinder pressure drops below 300 psi, interrupt the running cycle by pressing "RUN/STOP". Then press the soft key under "abort immediately". Or, if you have done this before and are confident that you can do the entire procedure within 5 minutes, wait for the beginning of a "SAMPLE" period. Make sure that it does not say "SAMPLE/FLOW AUDIT", but just "SAMPLE". Then the N_2 is not used and you can change the tank out before the next analysis without interrupting the cycle. The time you have before the end of the sample is indicated by the countdown in seconds.

Shut main tank valve, remove regulator, replace cylinder cap, and switch tanks with caps installed on cylinders (for safety). Strap new cylinder in place with chain. Install regulator on new cylinder and immediately check for leaks. Leak test as follows: open the tank valve and regulator outlet valve to pressurize the line, then close both valves. Watch that the indicated pressure on the tank (approx 2000 psi) does not drop over two minutes, and that the "purge" pressure gauge on the 8400N is also steady. Then reopen the tank valve and outlet valve, and adjust the regulator to deliver between 4 and 6 psi. If you have too much pressure, you will need to wait until the next analysis cycle to adjust the regulator properly. If you stopped the cycle, press "RUN/STOP" to resume normal operation.

11.4. Daily Checks

11.4.1. Frequency

These checks are straight forward and fast and should be done daily if an operator is already at the site. At a minimum, they should be done twice weekly.

Numbers in parentheses refer to log sheets.

11.4.2. Check the N_2 Cylinder (1)

Check the N_2 cylinder pressure at least twice per week by recording the main pressure gauge on the cylinder regulator. The main gauge is on the right hand side of the two gauges and reads between 200 and 2000 psi. Note any excessive drops in pressure, as these indicate a leak. When the pressure drops below 1000 psi, make sure a substitute cylinder is available. When the pressure drops below 300 psi, change to a replacement cylinder per instructions above under Section 11.3.2. Changing the N_2 Cylinder.

11.4.3. Check Calibration Gas Cylinder (1)

Note the pressure on the NO calibration gas cylinder, and check that the drop in pressure from the previous reading is not excessive. These cylinders are not replaceable on the time scale for the study, so if a leak is detected you should call ADI, and change from automatic to manual analyzer audits.

11.4.4. Refill Water Reservoir (1)

Open the cap at top of the reservoir water bottle, replenish with distilled water of the quality available from the grocery or hardware store. Replace the cap loosely; do not tighten, but allow for air to penetrate head space. Check that there appears to be water in the lines to the humidifier. This should be OK unless the water bottle has been allowed to become dry. If lines are dry, loosen the 1/4" nut on the side of the upper tee of the humidifier and let the humidifier fill from the bottle.

11.4.5. Check NO_x R-Cell Pressure (1)

To check the R-Cell pressure, look for the value in the middle of Pulse Analyzer display. If not displayed, press "test" to scroll through parameter list. If not between 4.7 and 5.3 in. Hg, then adjust the regulator at the back of analyzer. The data system records the R-Cell value.

11.4.6. Check and Record Orifice Flow Rotameter (1)

The orifice flow rotameter is the lower of the two rotameters located inside the Pulse Generator cabinet. The rotameter should read 0 during sample and 2-5 cc/min x100 during analysis (purge, baseline or read steps). Excess flow does not hurt the sample, but wastes nitrogen. Record the orifice flow during analysis and adjust to keep within range.

11.4.7. Check and Record Audit Data (2)

If the 8400N is set up to do automatic analyzer audits, then all that is needed is to record the data. With the system running, press "Data", "Select Data", "Audit Data"

and record most recent values on Analyzer Audit Sheet. ***Analyzer audit data are not sent to the data system, so your manual record is very important.***

11.4.7.1. If Zero has Drifted (2)

This is not critical as the system records the zero before each flash. But it is best to keep the zero within $\pm$5 ppb. The zero can be reset during the analysis step at the end of the N_2 purge and before the baseline read. Simply watch the system and press the "CAL" button on the Pulse Analyzer, then the "ZERO" button twice at the proper moment.

11.4.7.2. If Span has Drifted (2)

Span is indicated by the "Steady State Check" value returned by the analyzer audit. If the steady state check differs from the span gas concentration by more than 10%, you will need to stop and reset the zero and span following instructions on the Analyzer Audit log sheet, Appendix B: Maintenance Log Sheets. ***Be sure to note time of day NO_x analyzer span is reset***. After resetting the span, immediately conduct and record a manual audit. If the system is not set for automatic analyzer audits (as is possible if a leak is suspected in the cal gas cylinder), then conduct a manual audit at least weekly.

11.4.7.3. To Conduct a Manual Analyzer Audit (2)

This is only necessary if you have just reset the span, or if the system is not setup for automatic analyzer audits. Press "RUN/STOP" and F1 to finish current sample. If necessary, open the main tank valve and regulator outlet valve on the calibration gas cylinder. The cal gas gauge on the 8400N should read 5 $\pm$ 2 psi. Press "Menu", then "Enter Service Mode", then "Perform Analyzer Audit". Press "Full Audit". This starts the audit and will take 10 minutes. Record audit values on log sheet. At end of audit, press "Menu", then "Exit Service Mode" to get back to the main screen and then "RUN/STOP" to resume normal operation. Close the calibration tank valve and cal gas regulator outlet valve if a leak is suspected.

11.4.8. Routine Checks, Pulse Analyzer (3)

Check for a steady green light next to "sample". If light is not green, press "msg", note message and press "clear" to reset. You will get a message upon any power failure. On a cold start up, the ozone generator may not turn on for the first 30 minutes.

11.4.9. Routine Checks, Pulse Generator (3)

Verify the following:

- Status light should be off. If blinking or on, check and note status codes in upper left hand corner. Correct and/or clear using "reset status" soft key.
- The purge and cal pressure gauges should both read between 4 and 6 psi.
- Display should show "RUN" mode, and is active
- Display should show "Water Reservoir OK", and "Flash Strip OK"

- Check sample flow rate when “CURRENT STEP” reads “SAMPLE”. Should be between 0.9 and 1.1 L/min. If “CURRENT STEP” reads “PURGE”, “BASELINE”, “READ” or “WAIT” then the indicated flow is *not* the sample flow. Wait for system to enter step labeled “SAMPLE”, then read flow. If low, clean orifice, as described in Section 11.6.1.
- Specifically check that flash duration between 50-90 ms. From main screen press “data”. The flash duration is the last value listed. Press “ESC” to return to main screen.
- Open the cover and check rotameter and manual vacuum gauge readings per log sheet (Appendix B). Makeup flow should read between 3 and 5 L/min, orifice flow should read 0 during sample and 2-5 cc/min x100 during analysis (purge, baseline or read steps). Front vacuum gauge should read between -15 and -17 in Hg. Back vacuum gauge should read between -20 and -30 in Hg. If any readings are out of range, record their value before changing. Then adjust and note value after adjustment.
- Close door and verify that system is on main screen and in “RUN” mode.

11.4.10. Check Cyclone after Recent Rain (3)

If it has just rained, dry the cyclone. Unscrew the bottom, dry and replace. If you are quick, note the time and check while the system running. Note if a lot of water is visible.

11.4.11. Note Corrective Actions Taken (3)

Note any corrective actions taken. Specifically note if cell orifice is cleaned, if flash strip is replaced, or semi-monthly tests are run.

11.4.12. Note If Semi-Monthly Checks Run (4)

Note if the Semi-Monthly Check were completed, and fill out the Semi-Monthly Checks log sheet (see Section 11.5).

11.4.13. Fax Logs to ADI Weekly (5)

Please fax log sheets (Appendix B) to ADI each week at 510-649-9260. Include all sheets with new entries. At a minimum, fax Daily Checks and Analyzer Audit Data sheets.

11.5. Semi-Monthly Tasks

11.5.1. Measure Field Blank (6)

Press “RUN/STOP” and F1 to finish current sample. Connect disc cartridge filter in line, just above the black tubing above denuder. Use clear tubing to connect to sample line. Go to “Cycle Setup”, and adjust “Base Start Time” to “immed”. Press “Esc” to return to Main Screen and push “RUN/STOP” to run for two cycles. Reenter Cycle Setup and adjust “Base Start Time” back to “00:10”. Remove filter, reconnect sample line, press “RUN/STOP” to resume normal operation.

11.5.2. Clean Cyclone (7)

Unscrew the bottom of the cyclone, clean with water and Q-tip and reinstall. If you are quick, you need not stop system for this cleaning, but do note the time on the Semi-Monthly Checks log sheet (Appendix B).

11.5.3. Calibration with Aqueous Standards (8)

Press "RUN/STOP" and F2 to abort the current cycle. Retrieve the syringe, water in beaker and standard solution. Go to "Menu"—"Service Mode"—"Aqueous Standards". Open the cell. Rinse the syringe in water, then fill to desired volume (see below) with standard. Ensure no drops cling to outside of syringe by touching to mouth of standards bottle. Apply standard to center of strip by emptying syringe and touching to strip.

Press "Edit" to enter the "Mass Deposit" value in nanograms on the Pulse Generator screen. Close the cell and press "Start" to analyze standard. Note: Software version 0.535 includes a two minute waiting time before beginning analysis. With earlier software versions, the operator must wait two minutes before pressing "Start". Record the result on the "Aqueous Standards Log" log sheet (Appendix B).

Matrix of standards to run (300 ng NO_3 from $NaNO_3$):

No	Vol(μL)	ng nitrate	expected level
2	0.2	60 ng	1200-1400 ppb*s
2	0.4	120 ng	2400-2800 ppb*s
2	0.6	180 ng	3600-4200 ppb*s
2	0.8	240 ng	4800-5600 ppb*s
2	0.5	water blank	

Run a third standard if either of the two standards is out of range.

Rinse syringe thoroughly with water, and put away. Press "RUN/STOP" to resume normal operation.

11.6. Monthly Tasks (Every 4-6 Weeks)

11.6.1 Clean Orifice (9)

Clean the orifice every 4-6 weeks and whenever the sample flow rate drops below 0.9 L/min. First check that the front vacuum gauge reads between 15 and 17 inches Hg. If it is less than 15, readjust and check sample flow reading during the "sample" step. Do not use the reading during any other step. If sample flow is still low, then the orifice needs cleaning.

If the cycle is running stop it by pressing "RUN/STOP" and F2 to abort the run. Open the cell and unscrew the orifice using the yellow handled nut driver and large socket. Clean with distilled water using a squirt bottle. Dry with "portable air", and reinstall. Assure that orifice is tight, so that O-ring provides a vacuum seal. Press "RUN/STOP" to resume normal operation. When in sample step, check the flow rate with a flow

standard at the black tubing at the top of humidifier. Record reading from the flow standard and the flow indicated on the 8400N front panel. Reconnect the black tubing and close the Pulse Generator door.

11.6.2 Replace Flash Strip (10)

If the cycle is running stop it by pressing "RUN/STOP" and F2 to abort the run. Open the cell and unscrew the strip using the yellow handled nut driver and small socket. Remove the nuts, the washers and the strip. Place a new nichrome strip on the posts. The strips are in a clear plastic cylindrical container. Put the washers and then the nuts back on the posts. Go to "Menu"—"Service"—"FlashIR Setup". Press "Reset Flash Fault" if necessary and test flash once (press enter while the IR setting is highlighted). If the flash looked even and no sparks were seen close the cell, exit service mode and press "RUN/STOP" to resume normal operation

11.6.3 Check Make-Up Flow Filter (11)

This is OK as long as the makeup flow is between 3 and 5 L/min.

11.6.4 Check Analyzer Filter (11)

Ignore this for CRPAQS. It need only be done every three months, and will be fine for the duration of this study.

11.6.5 Leak Check (12)

With system in "READY" mode, close the green valve above the cyclone and close the front vacuum valve (below front vacuum gauge). Let the system pump down for several minutes. Then close valve below back vacuum gauge. Watch cell pressure reading on front panel. Drift upward should be less than 0.01 atmospheres/min. If OK, slowly reopen valve above cyclone, and reopen both vacuum valves.

12. Handling and Preservation of Samples

Not Applicable.

13. Sample Preparation

Not Applicable.

14. Preventative Maintenance and Repairs

Preventative maintenance issues are not addressed during the CRPAQS study since the instruments are only in the field for approximately three months. Expected issues upon extended field use include the following:

- Replacing or recharging (by baking out adsorbed material) the carbon denunder.
- Replacing the Teflon analyzer filter (every three months).
- Cleaning or replacing the aluminum inlet line.
- Cleaning any corrosion on the battery terminals of the Pulse Generator.
- Cleaning or replacing the fan filter on the Pulse Generator.

15. Troubleshooting

15.1. Status Codes

The 8400N responds to a variety of conditions and malfunctions with status code messages. Current status codes can be viewed by pressing "Status Codes" from the main screen. Every data record contains a representation of these status codes in a hexadecimal number called the OP code. See below for a list of OP codes, status codes and their description.

OP Code	Status Code	Description
00000000	Ok	No status conditions
00000001	Y	System Reset
00000002	Z	Power Failure
00000004	H1	A/D Failure
00000008	S1	Ambient Temp Out Of Range
00000010	S2	Ambient Pres Out Of Range
00000020	S3	Cell Comp Temp Out Of Range
00000040	E	Electronics Temp Out Of Range
00000080	W	Check H_2O Reservoir
00000100	X	Flash Failure
OP Code	Status Code	Description
00000400	FC	Cross Flow Sensor Fail
00000800	C1	Cross Flow Control Fail
00001000	P1	Abs Pressure Out Of Range
00002000	C2	Abs Pressure Control Fail
00004000	P2	Sample Pressure Out Of Range
00008000	D	Cell dp Out Of Range
00010000	R	Cycle Aborted
00020000	A1	Analyzer Warning
00040000	A2	Analyzer Communication Failure
00080000	A3	Analyzer Data Capture Start
00100000	A4	Analyzer Data Capture Checksum
00200000	A5	Analyzer Data Capture Incomplete
00400000	A6	Analyzer Data Capture Timeout
00800000	U	Amb Temp Sensor Not Used

This hexadecimal system for OP codes is used so that combinations of status codes can easily be identified. For example: the OP code for Flash Failure, Sample Flow Out Of Range, and Cycle Aborted would be reported as "00001300" (00000100 + 00000200 + 00001000). Cross Flow Sensor Fail and Cross Flow Control Fail would be reported as "00000C00" (00000400 + 00000800).

Below are listed common status codes and their remedies.

15.1.1. Ambient Temp Out of Range

Possible failed ambient temperature probe. Ensure that the probe is properly connected to the Pulse Generator, and that the probe itself is not wet and is in good condition.

15.1.2. Check H_20 Reservoir

Add water to H2O Reservoir water bottle. If the bottle appears full, check that the humidifier line is full of water and contains no large bubbles. If the humidifier line appears normal, the conditioned humidity sensor may need to be removed and dried.

15.1.3. Flash Failure

Replace the flash strip if it is visibly broken (see Section 11.6.2). Also check for burrs on the aluminum posts on which the strip rests. Any burrs or pitting may be removed by sanding with emery paper. If the strip does not appear broken, reset the flash fault in "Menu"—"Service Mode"—"Flash/IR Setup" and run a test flash while observing the strip. Repeated flash faults may indicate a battery problem or other electronic problem.

15.1.4. Sample Flow Out of Range

Clean the sample orifice. See Section 11.6.1.

15.1.5. Cross Flow Control Fail

This is most likely due to a problem with the N_2 tank. Ensure there is sufficient pressure remaining in the tank. See Section 11.3.2.

15.1.6. Analyzer Warning

Note warning messages on Pulse Analyzer screen (press "MSG"). Clear messages by pressing "CLR".

15.2. Other Concerns or Questions

For any other concerns or questions, please call Brent Kirby or Susanne Hering at ADI, (510) 649-9360.

16. Data Acquisition, Calculations, and Data Reduction

16.1. Data Acquisition

There are three types of data, "Cycle", "Audit" and "Standards". For software version 0.532 or later, and with the communications protocol set to "CycleDat", the "Cycle" data will download automatically via the RS-232 port to the site data acquisition system. For the prior version, commands were needed. Both are described in Table 2: Output Format and Expected Values for 8400N Cycle Data. Audit and Standards data should be downloaded manually. Cycle data can also be downloaded manually as described in Appendix A: Quick Start Guide. The data is comma delimited. The order of parameters, their names and their units are given in Table 2.

16.2. Data Reduction

Data are adjusted to account for the following:

- Average aqueous standard calibrations
- Field blank readings
- Variations in analyzer audit span
- Variations in the R-Cell pressure
- Independent flow measurements
- Temperature and pressure correction to sample flow when no ambient temperature sensor installed

Log books and site summaries will be reviewed. Invalid and suspect data will be flagged as such.

17. Computer Hardware and Software

See Appendix A: Quick Start Guide.

18. Data Management and Records Management

The data set consists of the "Cycle Data" which is sent directly to the site data system, plus the analyzer audit, aqueous standards and field blank data, which are recorded by the operator on the log sheets. There are four log sheets:

- Daily Checks
- Analyzer Audit Data
- Semi-Monthly Checks
- Aqueous Standards Log

The "cycle" data from the 8400N should be reviewed daily to ensure that the system parameters are within an acceptable range, as listed in Table 2: Output Format and Expected Values for 8400N Cycle Data. This can be done most easily by personnel who receive the data remotely.

- Note if there are sudden changes to "flash duration" or "Panal", and that data values trend smoothly.
- If parameters are out of specification, please contact Brent Kirby or Susanne Hering at Aerosol Dynamics.

Log sheets, which include audit and standards data, should be faxed to ADI for review each week at (510) 649-9260.

19. References

Stolzenburg, M. R. and Hering, S. V., A New Method for the Automated Measurement of Atmospheric Fine Particle Nitrate, *Environ Sci and Technol.* 34: 907-914 (2000)

Table 1: System Parameters and Settings

Menu Item	Value	Comment
Cycle Setup		
Sample Time	525	*these parameters determine timing of cycle steps*
Purge Time	20	
Baseline Read	10	
Read 1 time	20	
Read 2 time	1	
Base Start Time	0:10	*will start even 10-min past hour*
Minimum Cycle Length		*calculated value*
Desired Cycle Length	600	
Number of Cycles	0	*runs continuously*
Perform Flow Audit	24	*note: flow audit does not stop sample*
Start Analyzer Audit	01:00	*time of day for automatic analyzer audit with cal gas*
Perform Analyzer Audit	2	*runs automatic analyzer audit every second day*
Audit Setup		
Steady State Check	220	*these parameters determine timing of audit steps*
Read NOx 1	30	
Flow Balance Check	120	
Read NOx 2	30	
Line Purge	120	
Read NOx 3	30	
NOx Pulse Read	30	
8400 Setup		
Conv. Fact. Calc	AUTO	*these are calibration and control*
Conv. Fact.		*factors for nitrate analysis*
Anal Cross Flow	85%	
% Theor. Conv.	85.00%	
System Setup		
RS-232 Setup		
Protocol	CycleDat	*for automatic download of cycle data to computer*
Baudrate	19200	
Com para 1	52	
Com para 2	75048	
Com para 3	13010	
Com para 4	0	

Table 2: Output Format and Expected Values for 8400N Cycle Data

Command Sequence to Retrieve Data every 10 minutes

With CycleDat Protocol available on Software version 0.532 or later, cycle data will be dumped automatically.

Data record is comma delimited. All except Date, Time, and OP fields are decimal numbers. OP field is hexadecimal.

Order of Variables Sent, Units and Expected Values

Name (Data Sys.)	Name (8400N)	Units	Acceptable Range
1. Date	Record Date	none	
2. Time	Record Time	(PST)	
3. Tamb	Amb Temp	©	
4. Pamb	Amb Pres	(atm)	
5. RHamb	Amb % RH	(%)	
6. RHcond	Cond % RH	(%)	70-100
7. Tbox	Cell Comp T	©	Tamb±10
8. Qsmp	Sample Flow	(L/m)	0.8-1.1
9. Qxflo	Cross Flow	(L/m)	80±5% of Qanal
10. Qanal	Analyzer Flow	(L/m)	0.7 - 1.0
11. Psmp	Ave Samp Pres	(atm)	0.35-0.5
12. dPanal	Cell dp	(inH2O)	-5 to -15, change<±1
13. Prcell *	RCell Pres	(in Hg)	4.6-5.3
14. tsmp *	Sample Time	(s)	set value, usu. 525
15. tread1	Read 1 Time	(s)	20
16. NOxamb	Average NOx	(ppb)	0-300
17. BslnArea	Baseline Area	(ppb*s)	<100
18. FlsArea	Pulse 1 Area	(ppb*s)	
19. ThConvFact *	Conv Fac	(ppb*s/ng)	20-30
20. CalFact **	Theor Conv %	(%)	75-90
21. dtFls	Flash Dur	(ms)	40-80
22. NO3	Nitrate Conc	(ng/L)	0-100
23. OP	none	none	000000

Changes from Software version 0.513 to 0.532

*version 0.513 data system output:

13.t-smp	Sample Time	(s)	set value, usu. 515
14.t-bsln	Bsln Read Time	(s)	10
19.ConvFact	Conv Fac	(ppb*s/ng)	20-30

** added line in version 0.532 output

With Software version 0.513, a new inquiry must be sent to 8400N every 10 minutes [labview instruction: freq=10]. The following instructions to the 8400N will download the last record:

Instruction	Comment
"<cntrlB>4SSTO K0 E <cntrlC>"	to set stack pointer to the last record
"<cntrlB>4ASTO K0 1 <cntrlC>"	to download the last record

Appendix A: Quick Start Guide

QUICK START GUIDE

SERIES 8400 AMBIENT PARTICULATE NITRATE MONITOR

May 2000

Revision A

R&P Part Number 42-007037

Rupprecht & Patashnick Co., Inc.
25 Corporate Circle
Albany, NY 12203 USA

phone 518/452-0065
fax 518/452-0067

the new microweighing technology

IMPORTANT NOTE

This guide is meant to assist users in setting up the Series 8400N Ambient Particulate NItrate Monitor. It describes the primary steps involved in setting up the hardware, performing a primary manual leak check, preparing a sample and running a cycle and calibrating the hardware with the aid of photographs and short descriptions.

While this document serves as a general guide, it does not provide the depth contained in the product's operating manual. For installation issues not covered in this guide, as well as other topics such as maintenance and quality assurance, refer to the operating manual supplied with the instrument.

Table of Contents

Section 1: Setting up the Hardware

1 *Ensuring Proper Accessories*

Unpack the box containing the instrument, and make sure that the accessories package contains the following components:

- 1 ambient temperature/relative humidity module with 20 ft. cable and hose clamp
- 1 pump with 25 ft. of 3/8" tubing and T-hose connector
- 2 ft. 3/8" tubing
- 10 m aluminum inlet tubing
- 6 m duct hose with hose clamps
- 1 inlet hood
- 2 ft. 1/8" Teflon tubing
- 10 m 1/4" Teflon tubing
- 1/4" drive socket handle
- 1 5/16" socket
- 1 1/4" socket
- 25 mm in-line filter holder
- 10 25mm membrane filters
- 10 NiChrome flasher strips
- 2 9-to-9 pin computer cables
- 2 power cords
- 1 8400 upload adapter
- 1 I/O adapter
- 1 Pulse Analyzer regulator with 3/8" camozzi fitting
- 1 swagelock fitting port connector
- 1 humidifier bottle
- 1 charcoal filter
- 3 Balston filters
- 2 replacement fuses
- 1 manual package

2 *Setting Up the Pulse Generator and Pulse Analyzer*

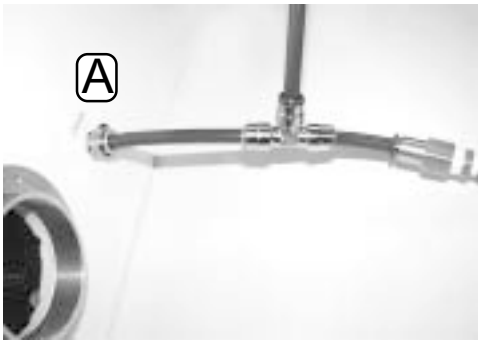
Unpack the boxes containing the Pulse Analyzer (A) and Pulse Generator (B). Place these two parts of the monitor within 2 feet of each other.

A

B

3

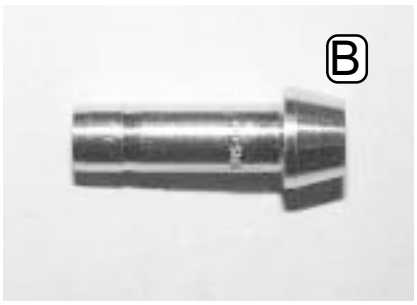
A

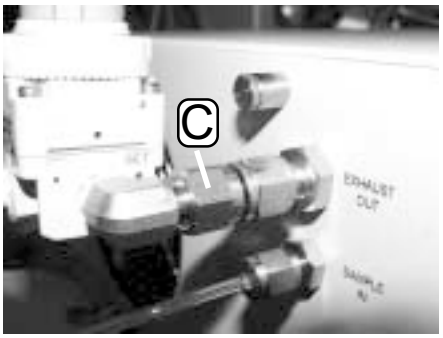


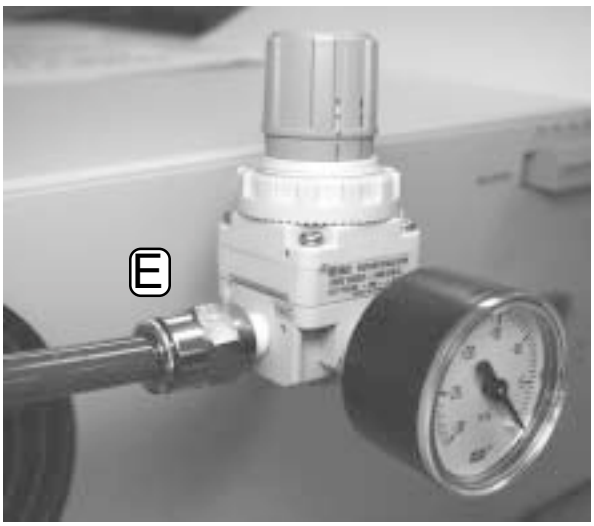
Setting Up the Pump

Set up the pump either in an outside location or a sound-isolated location. Attach one end of the 25-foot blue hosing to the pump. Attach the other end of the 25-foot hosing (the T-hose connector) to the “VACUUM" port on the back of the Pulse Generator (A).

4







Setting Up the Pulse Analyzer Regulator

Loosen the fitting on the "EXHAUST OUT" port on the back of the Pulse Analyzer (A) and remove the ferrule inside the nut. Insert the larger end (B) of the swagelock fitting port connector into the "EXHAUST OUT" port. Tighten the fitting until the fitting port connector is secure. Loosen the fitting on the elbow joint of the pulse analyzer regulator (C). Slide this fitting onto the fitting port connector and tighten the nut. Insert one end of the extra 3/8" hosing into the open push-to-connect fitting on the T-hose connector (D). Insert the other end of the 3/8" hosing into the push-to-connect fitting on the pulse analyzer regulator (E).

5

Preparing the Metal Inlet Tubing

Feed the metal inlet tubing through the duct hose. Run this dual-hose assembly through the ceiling. Make sure that you have enough metal tubing to extend completely through the ceiling. Attach the other end of the dual-hose assembly to the sample inlet on the top of the Pulse Generator. Slide the end of the metal inlet tubing into the compression fitting on the sample inlet and tighten the nut. Slide the end of the duct hose on the top inlet and secure it with a hose clamp.

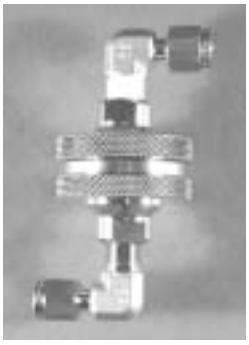
6

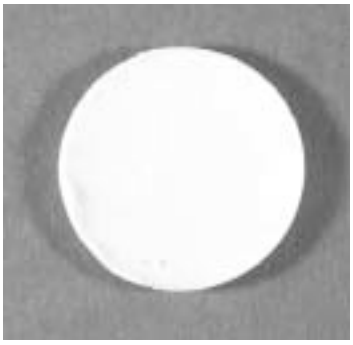
Setting Up the Span Gases

Set up the purge and span gas canisters. Attach regulators with 1/4" swage fittings to the canisters. Cut the 1/4" Teflon tubing to extend from the gas canisters to the Pulse Generator. Attach one end of each section of the 1/4" Teflon tubing to the 1/4" swage fittings on the regulators. Be sure to tighten the swage fittings 1-1/4 turn past finger-tight with a wrench. Attach the other end of the 1/4" Teflon tubing to the 1/4" swage fittings on the appropriate gas ports of the Pulse Generator.

NOTE: You must use dual-stage, stainless steel regulators for the span gas canisters.

7

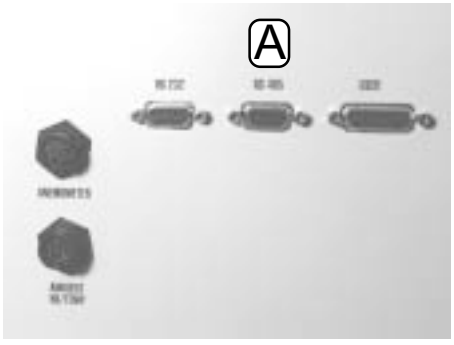




Setting Up the In-Line Filter Holder

Attach the in-line filter holder to the "ANALYZER" port on the Pulse Generator. Unscrew the filter holder and place a 25 mm membrane filter between the black o-ring and the filter screen inside the holder. Be sure to place the black o-ring on top of the membrane filter before closing the in-line filter holder. Screw the in-line filter holder together and tighten with a wrench until leak tight. Insert one end of the 1/8" Teflon tubing into the open end of the in-line filter holder. Attach the other end of the Teflon tubing to the “SAMPLE IN” port on the Pulse Analyzer (A). Ensure that there is less than 2 feet of Teflon tubing between the Pulse Generator and the Pulse Analyzer.

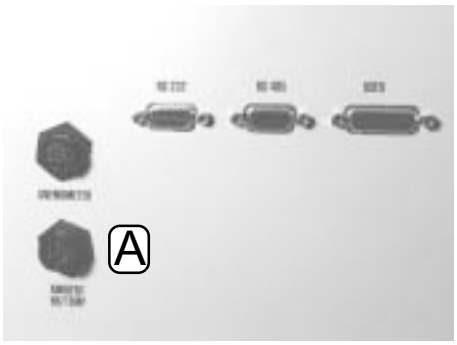
8



Attaching the Communication Cables

Attach one end of the 9-to-9 pin computer cable to the RS485 port on the back of the Pulse Generator (A). Attach the other end of the cable to the RS485 port on the Pulse Analyzer (B).

9



Installing the PVC Inlet

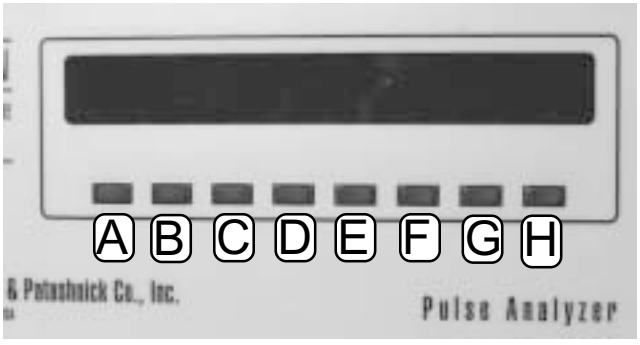
Run a section of PVC piping through the roof. Feed the end of the metal inlet tubing through the PVC piping. Attach the end of the duct hose to the bottom of the PVC piping. Center the end of the metal tubing in the top of the PVC piping. Slide the PVC inlet onto the top of the PVC piping. Attach the ambient temperature/relative humidity module to the PVC piping, just below the PVC inlet, with a hose clamp. Run the module's 20-foot cable alongside the PVC piping through the roof. Plug the end of the cable into the back of the Pulse Generator (A).

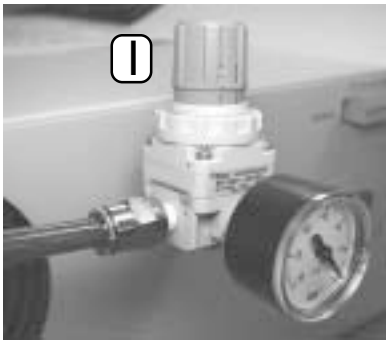
10

Attaching the Power Cords and Turning On the Instrument

Attach one of the power cords to the power connection on the Pulse Generator (A). Plug the other end into an appropriate power source. Attach the other power cord to the power connection on the back of the Pulse Analyzer (B). Plug the other end into an appropriate power source. Turn on the pump. Turn on the Pulse Analyzer by pushing the power switch on the front of the unit (C).

11

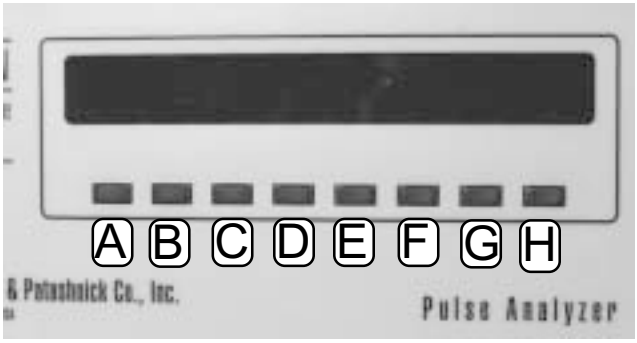


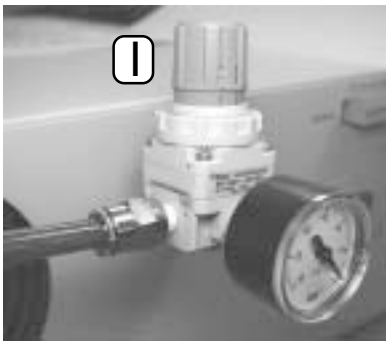


Setting RCEL

Press the "A" button once on the Pulse Analyzer. If RANGE does not equal 10000, go to step 12. If RANGE = 10000, then press the "B" button until RCEL is displayed on the screen. Pull up on the knob of the pulse analyzer regulator (I) to display the orange strip. Turn this knob until RCEL = 5.0. When RCEL = 5.0, push the regulator knob down to hide the orange strip.

12

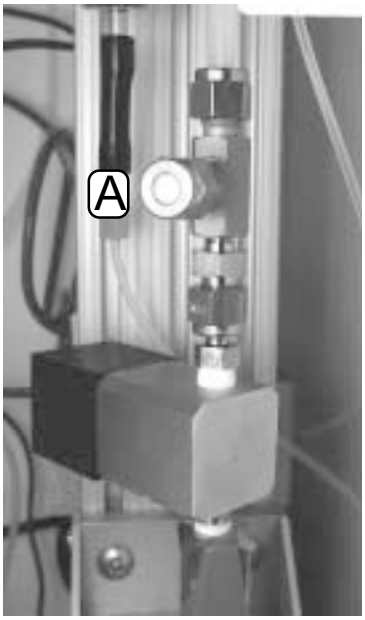


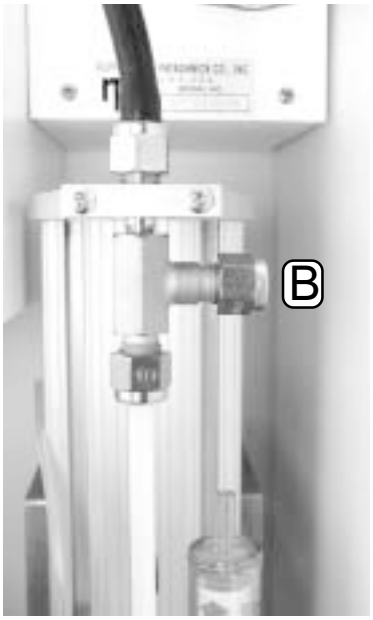


Setting RANGE and RCEL

Press the "A" button once on the Pulse Analyzer. If RANGE does not equal 10000, press the "H" button once. Press the "C" button once (this is labeled "RNGE" on the screen). Press the "B" button once (this is labeled "SET" on the screen). Set the RANGE by pressing buttons "A" to "E" to display "10000." When you have set the RANGE to "10000," press the "G" button once (this is labeled "ENTR" on the screen). Press the "H" button once (this is labeled "EXIT" on the screen). The RANGE should now be equal to 10000 on the screen (RANGE = 10000). Press the "B" button until RCEL is displayed on the screen. Pull up on the knob of the pulse analyzer regulator (I) to display the orange strip. Turn this knob until RCEL = 5.0. When RCEL = 5.0, push the regulator knob down to hide the orange strip.

13

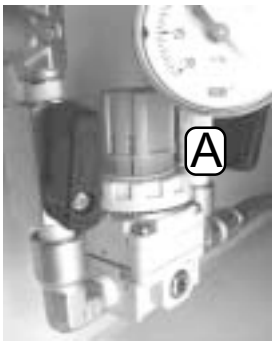


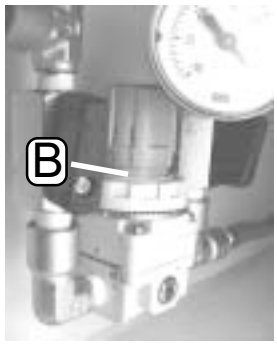


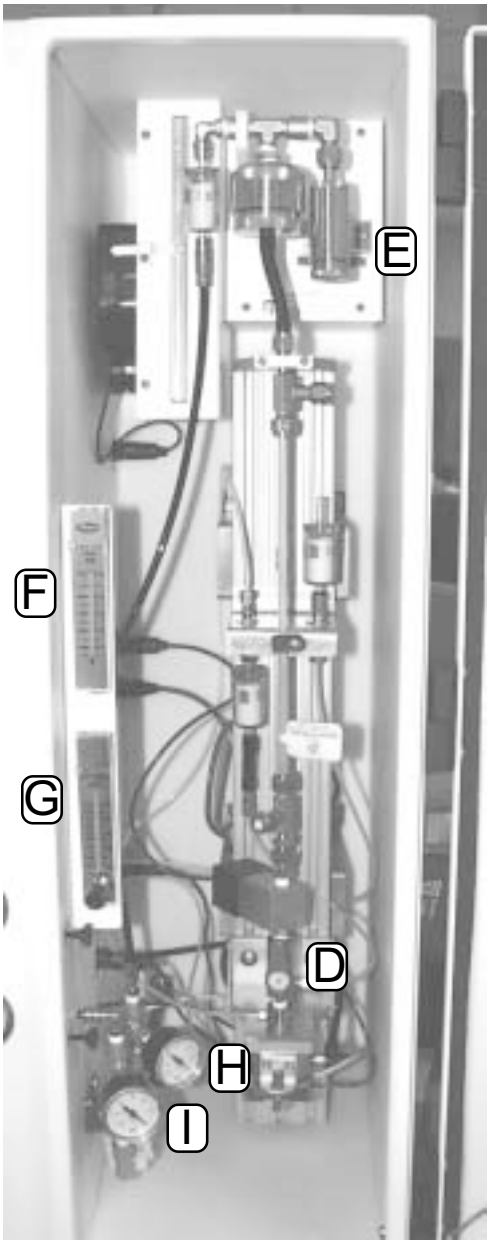
Setting Up the Humidifier

Cut a 20" length of the 1/4" hose. Run it through the hole in the top of the Pulse Generator. Loosen the 1/4" swage fitting on the bottom of the PermaPure humidifier (A). Insert the hose into the fitting and tighten the fitting. Be sure to tighten the swage fittings 1-1/4 turn past finger-tight with a wrench. Insert the other end of the 1/4" hose (that is protruding from the top of the Pulse Generator) into the push-to-connect fitting on the humidifier bottle. Fill the bottle with deionized water. Loosen the nut on the top of the humidifier (B) until water begins to flow out of the nut. Tighten the nut securely.

14



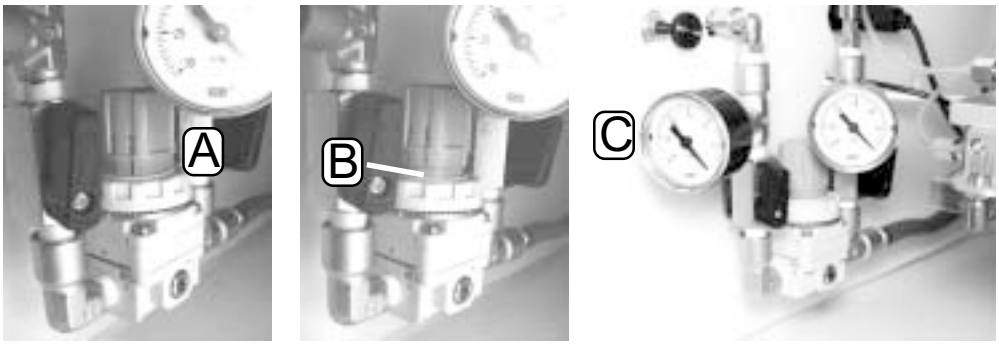




Performing a Primary Manual Leak Check

Open the door of the Pulse Generator. **IMPORTANT: Ensure that the pump is turned on before performing the manual leak check.** Pull up on the knob of the cell regulator (A) to display the orange strip (B). Turn the knob to completely open the flow. You will know that the flow is completely open when the regulator knob hits a stop and when the cell vacuum gauge (C) reads around or above 25 inches. Ensure that the sample valve (D) is open. Close the inlet valve (E). Allow the rotometers (F and G) to settle. Close the makeup flow valve (H) (located toward the back of the unit) and the sample/bypass flow valve (I) (located near the front of the unit). Wait 1 minute. Open the sample/bypass flow valve (I). When you open this valve, watch the cell vacuum gauge (C). If the needle on the gauge moves, there is a leak in the system. Refer to Section 4 for further information on isolating the leak in the system. If the needle of this gauge remains steady, then there are no leaks in the system. If there are no leaks in the system, open all the valves and turn on the Pulse Generator by pushing the power switch on the front of the unit (J). Refer to Section 2 for information on setting up the software.

15



Adusting the Cell Vacuum

Pull up on the knob of the cell regulator (A) to display the orange strip (B). Turn the knob until the cell vacuum gauge (C) is at 1/2 ATM (roughly 15-16 inches at sea level). When the cell vacuum gauge displays 1/2 ATM, push the knob of the cell regulator down to hide the orange strip.

Section 2: Setting Up the Software

This section explains how to set up software in the Pulse Generator.

1 *Navigating Through the Software*

Use the keypad on the Pulse Generator to navigate through the software. The system software allows the user to navigate easily through the use of soft function keys (<F1> to <F10>) and the <ESC> key. From the Main screen, press <F1: Status Codes>, <F2: Current Stats>, <F3: Data>, <F5: Cycle Setup> or <F6: System Setup> to drop down one level in the screen structure.

Pressing the <ESC> key causes the current display to be replaced by the next higher screen in the hierarchy. For example, pressing <ESC> when in the Status Codes screen returns the user to the Main screen. The definitions of the soft function keys changes as different screens appear on the display and different functions are required. Many screens allow the user to change the value of system parameters.

2 *The Title Screen*

When you turn on the Pulse Generator for the first time, the Title screen momentarily appears on the monitor's display to identify the model number of the unit and the revision number of the installed software.

Series 8400
Nitrate Monitor

Version 1.000
Copyright 2000, Rupprecht and Patashnick Co.

				26-Feb-2000 13:50:01	
					Full Reset

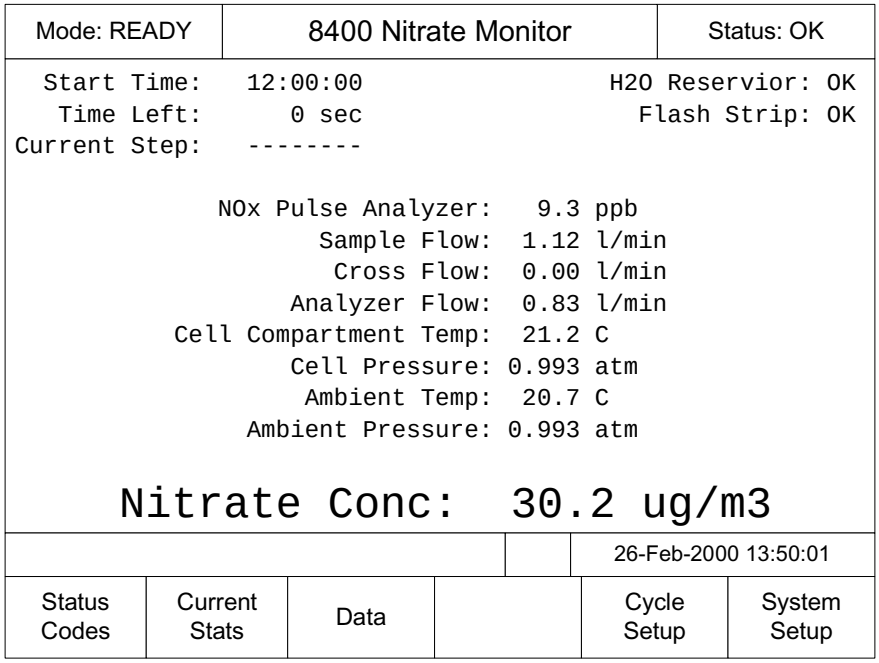
3 *The Main Screen*

After a few seconds, the Title screen is automatically replaced by the Main screen. The Main screen contains the monitor's current operational parameters.

When viewing the Main screen before running a cycle, ensure that the monitor is in the Ready Operating Mode ("READY"). The operating mode is located in the top left corner of the Main screen. To run a cycle, you must enter the Cycle Setup screen. From the Main screen, press F5: Cycle Setup> to enter the Cycle Setup screen.

If the monitor is in the Wait Operating Mode ("WAIT") this indicates that it is not able to initiate a cycle. The user must check and clear the instrument's status codes before it can begin running a cycle.

The Stop Operating Mode ("HALT") indicates that a critical error has occurred while the instrument was running a cycle. The Service Operating Mode ("SERVICE") is used while calibrating or repairing the instrument.



4 *The Cycle Setup Screen*

While in the Main screen, press <F5: Cycle Setup> to enter the Cycle Setup screen. In this screen, you can enter your sample time, purge time, baseline read time, read 1 time and read 2 time. You may enter a zero (0) in the Read 2 Time field to disable the Read2 and Flash2 steps.

You also may enter the base start time which allows you to start your cycle on the next 5, 10, 15, 30 or 60 minute interval after you press the <RUN/STOP> key. For example, if you set the Base Start Time to 5 minutes and the current time is 12:07, then the instrument would begin running the next cycle (after you pressed the <RUN/STOP> key) at 12:10. You may also choose to start your cycle immediately after pressing the <RUN/STOP> key by setting the Base Start Time to "IMMED."

The Minimum Cycle Length can not be edited by the user. It is simply the sample, purge, baseline read, read 1 and read 2 times added together with a few extra seconds allowed for instrument operation.

The Desired Cycle Length can be edited by the user. The default value for Desired Cycle Length is actually the Minimum Cycle Length. You can enter a larger value than the Minimum Cycle Length in this field, but not a smaller value. If you do not want any delay between cycles, enter a zero (0) in this field.

The Number of cycles field determines how many cycles the monitor will run. To run cycles continuously, enter a zero (0) in this field.

After you have entered the appropriate information in this screen, press the <RUN/STOP> key to begin running a cycle.

NOTE: You must follow the instructions in Section 3: "Setting Up the Sample" before pressing the <RUN/STOP> key to begin running a cycle.

Mode: READY	Cycle Setup	Status: OK

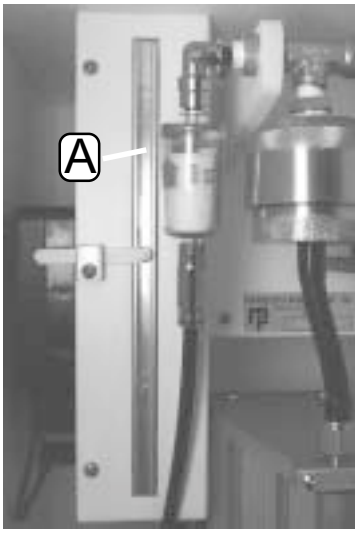
```
                Sample Time:   530 sec
                 Purge Time:    30 sec
         Baseline Read Time:    10 sec
                Read 1 Time:    20 sec
                Read 2 Time:     1 sec
   (Enter 0 to disable second flash and read step)

            Base Start Time: 00:10
       Mininum Cycle Length:   557 sec
       Desired Cycle Length:   600 sec
     (Enter 0 to eliminate delay between cycles)

           Number of cycles:     0 cycles
            (Enter 0 to run continuously)
```

				EDIT	19-Feb-2000 12:00:00	
						8400 Setup

Section 3: Preparing the Sample

This section explains how to set up sample in the Pulse Generator.

1



The Filter Fan

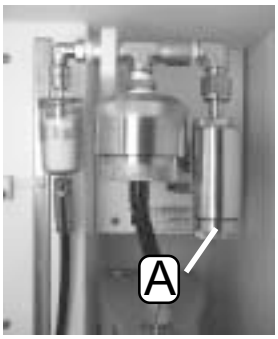
Ensure that the filter fan (A) is in its holder. Pull the plastic latch up and slide the filter out. Check the filter to make sure that it is clean and undamaged. Slide it back into the filter holder and push the plastic latch down into its bracket.

2

The Charcoal Filter

Ensure that the charcoal filter is undamaged and in its holder. Pull the hose off the bottom of the charcoal filter housing (A). Unscrew the bottom of the charcoal filter housing and remove it from the charcoal filter assembly. Make sure that the charcoal filter is undamaged and properly positioned in the holder (it should be placed on top of the black o-ring inside the bottom of the holder). Screw the bottom of the charcoal filter housing onto the charcoal filter assembly. Reattach the hose to the assembly.

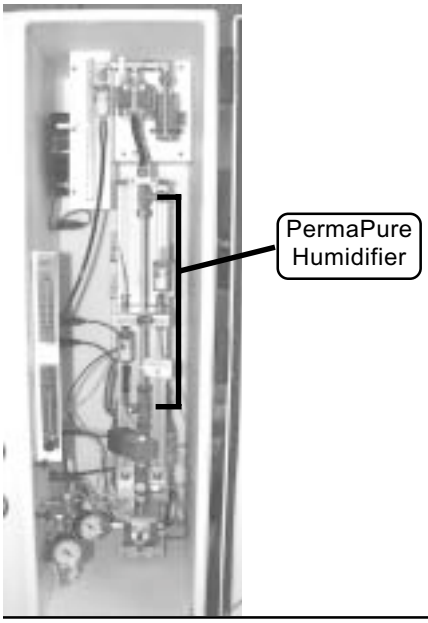
3



The Cyclone

Ensure that the cyclone (A) is clean and in place. Unscrew the cyclone and remove it from the cyclone assembly. Make sure that the inside of the cyclone is clean. Screw the cyclone onto the cyclone assembly.

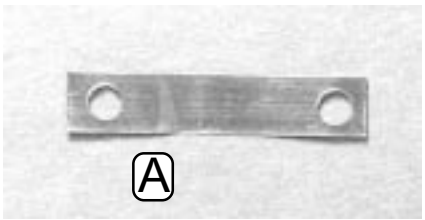
4



The Humidifier

Ensure that the PermaPure humidifier is filled with deionized water. Refer to Section 1, step 13 for further instructions.

5



The Flasher Strip

Ensure that the flasher strip (A) is undamaged and in place. Unscrew the knob on the front of the cell assembly and push the tab to the side to open the cell assembly. Pull the bottom of the cell assembly down to display the flasher strip. Ensure that the flasher strip is undamaged and mounted on both posts. If you must replace the flasher strip, refer to Section 7 for further instructions. Push the bottom of the cell assembly up and line the tab up so that it holds the assembly together. Tighten the knob.

The Pulse Generator is now ready to sample. Ensure that the software is set up properly (Section 2) and press the <RUN/STOP> key.

Section 4: Downloading Data

This section explains how to download data from the Pulse Generator.

1 *Connecting the 9-To-9 Pin Cable*

To download data from the Pulse Generator, you must connect a 9-to-9 pin computer cable from the instrument to your personal computer (PC). Connect one end of the 9-to-9 pin cable to a 9-pin port on your PC. Connect the other end of the cable to the RS232 connector (A) on the front of the Pulse Generator.

2 *The Cycle Data Screen*

To download data from the Pulse Generator, you must go to the Download Data screen. While in the Main screen, press <F3: Data> on the Pulse Generator's keypad to display the Cycle Data screen.

Mode: READY	Cycle Data	Status: OK

```
     Record #:       67          Record Date: 2000-May-10
 Status Codes:       Ok          Record Time:    11:20:00

                Nitrate Conc:  30.1 ug/m3

   Amb Temp:  23.4 C       Analyzer Flow:  0.86  l/min
   Amb Pres: 0.986 atm        Sample Vol:  577.3 l
    Amb %RH:  45.1 %         Sample Time:    530 sec
Average NOx:  22.1 ppb     Baseline Time:     10 sec
  Comp Temp:  25.1 C        Baseline Ave:    4.3 ppb
Sample Pres: 0.492 atm       Read 1 Time:     20 sec
    Cell dP:  16.2 inH2O    Pulse 1 Area:  741.3 ppb*s
   Cond %RH:  91.3 %         Conv Factor:  29.32 ppb*s/ng
Sample Flow:  1.09 l/min   Flash Duration:    89 ms
```

			EDIT	2000-May-10 12:30:01	
Status Codes			Jump To Record	Download Data	Data Logger

3 *The Download Data Screen*

While in the Cycle Data screen, press <F5: Download Data> to display the Download Data screen.

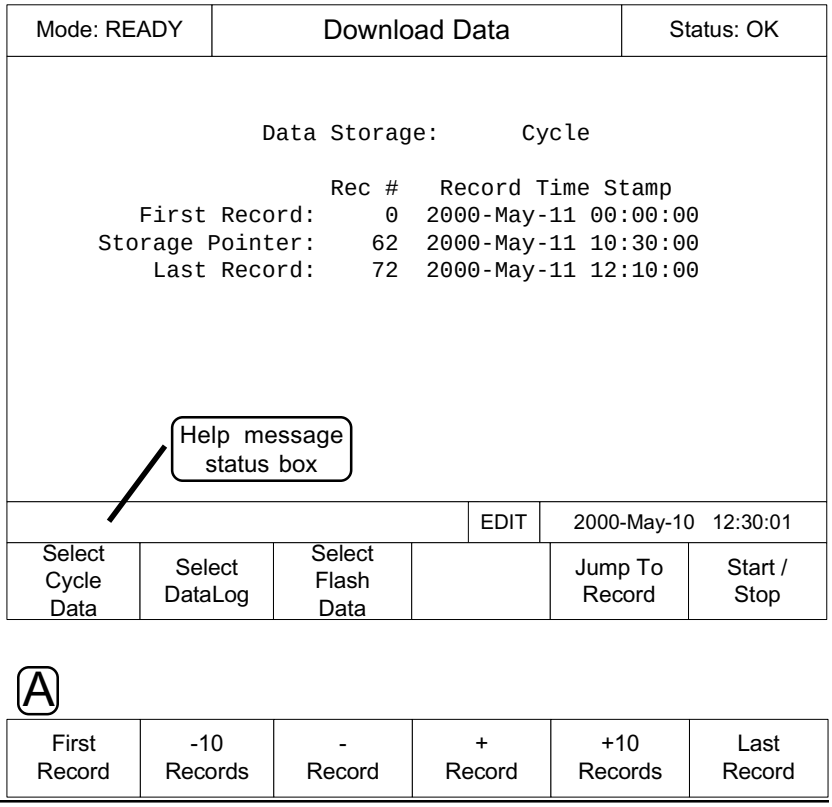
Select which type of data you would like to download by pressing <F1: Select Cycle Data>, <F2: Select DataLog> or <F3: Select Flash Data>.

Move the storage pointer to the record at which you would like to begin downloading by pressing <F5: Jump To Record>. A new line of soft keys (A) will appear on the bottom of the screen that will allow you to select the appropriate record at which to begin downloading. Press the <ESC> key when you are finished setting the storage pointer.

Initiate HyperTerminal or some other data capture software program on your PC. Press <F6: Start/Stop> on the Pulse Generator to begin downloading data.

The "help message status box" will display "Downloading (data type)" when downloading is occurring. If you must abort the data download, press <F6: Start/Stop> again to stop the download.

When the download is complete, disconnect the 9-to-9 pin cable.



Section 5: Uploading New Software

This section explains how to upload a new software program into the Pulse Generator.

1

Connecting the Communication Cable

Turn off the Pulse Generator before uploading a new software program into the instrument. Connect the 8400 upload adapter to the RS232 connector (A) on the front of the Pulse Generator. Connect a 9-to-9 pin computer cable to the other end of the 8400 upload adapter. Connect the other end of the cable to a 9-pin port on your personal computer (PC).

2

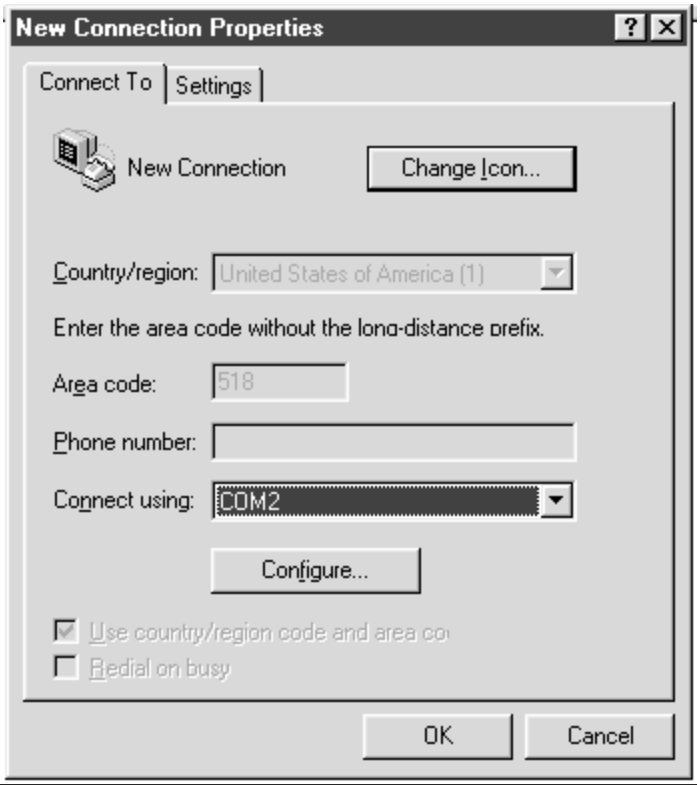
New Connection Properties Screen

Download the new software program from R&P's website. Initiate your communication software application, such as HyperTerminal, on your PC.

Select "File" and "Properties" to display the "New Connection Properties" screen. There are two layers or "tabs" to this screen: "Connect To" and "Settings." Ensure that the "Connect To" layer is displayed on the screen.

In the "Connect using:" field, ensure that "COM1" or "COM2" is selected.

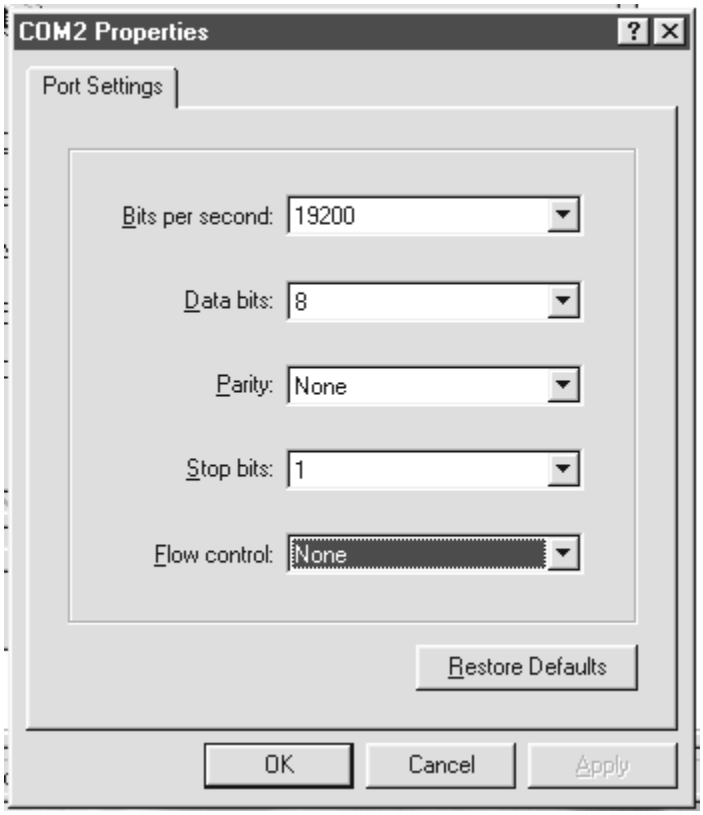
Select the "Configure..." button to display the "COM{1 or 2} Properties" screen.



3 *COM Properties Screen*

While in the "COM{1 or 2} Properties" screen, ensure that the "Bits per second:" field displays "19200," the "Data bits:" field displays "8," the "Parity:" field displays "None," the "Stop bits:" field displays "1," and the "Flow control:" field displays "None." Select the "OK" button.

The New Connection Properties screen will reappear. Select the "OK" button.

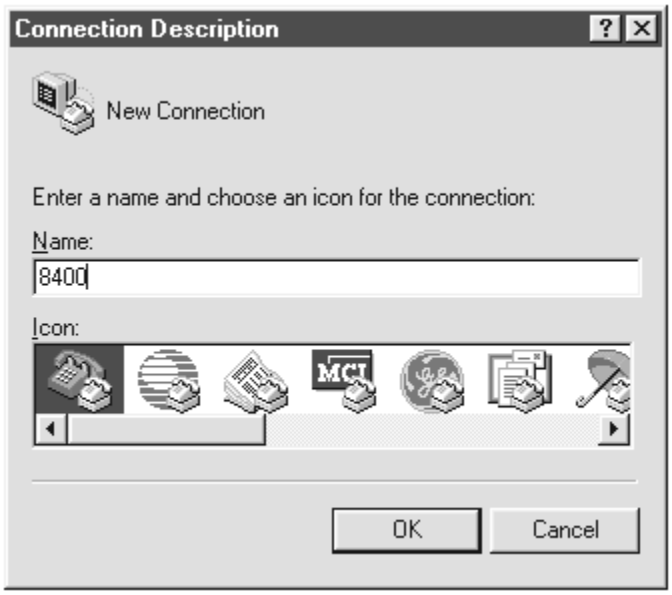


4 *Saving the Configuration*

Select "File" and "Save" to save your new connection configuration. This will display the "Connection Description" screen.

Enter a name for your new connection and select the "OK" button.

Exit your communication software application.

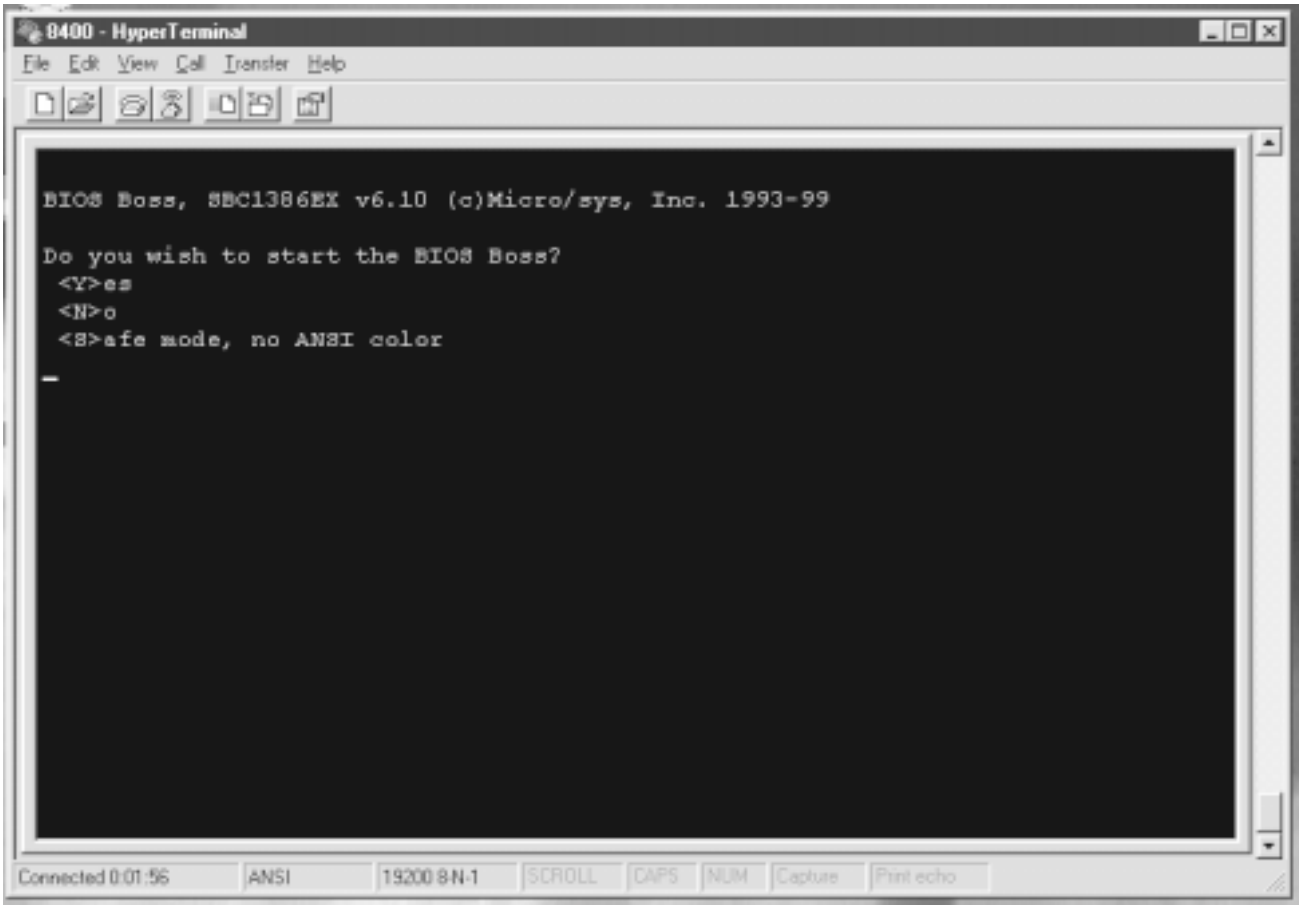


5 *Re-Entering Your Communication Software Application*

Re-enter your communication software application and select the connection that you just created.

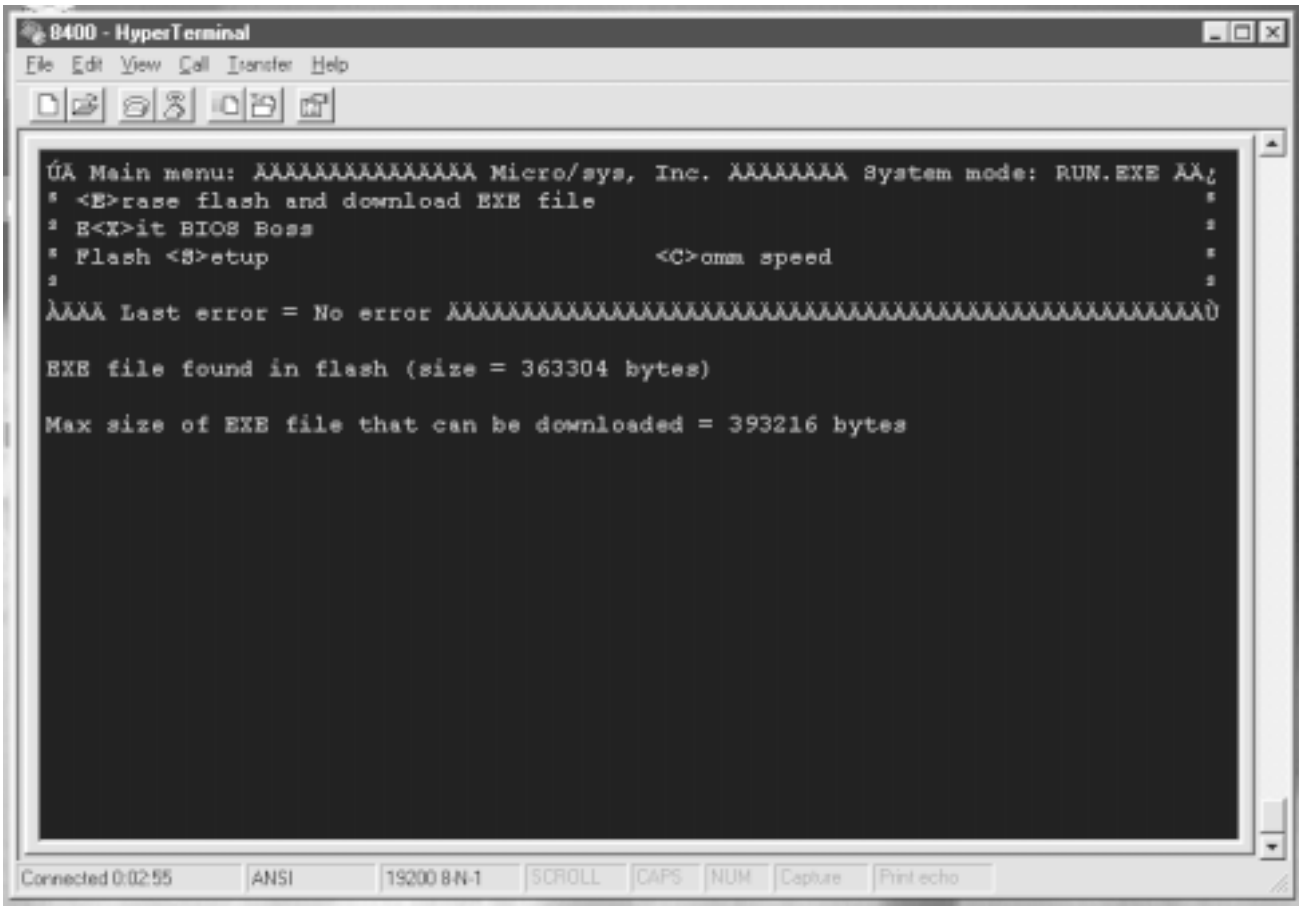
6 *Turning on the Pulse Generator*

Turn on the Pulse Generator. The "BIOS Boss" screen will display on your PC. Press the "Y" key on your PC's keyboard to initiate the BIOS Boss software.



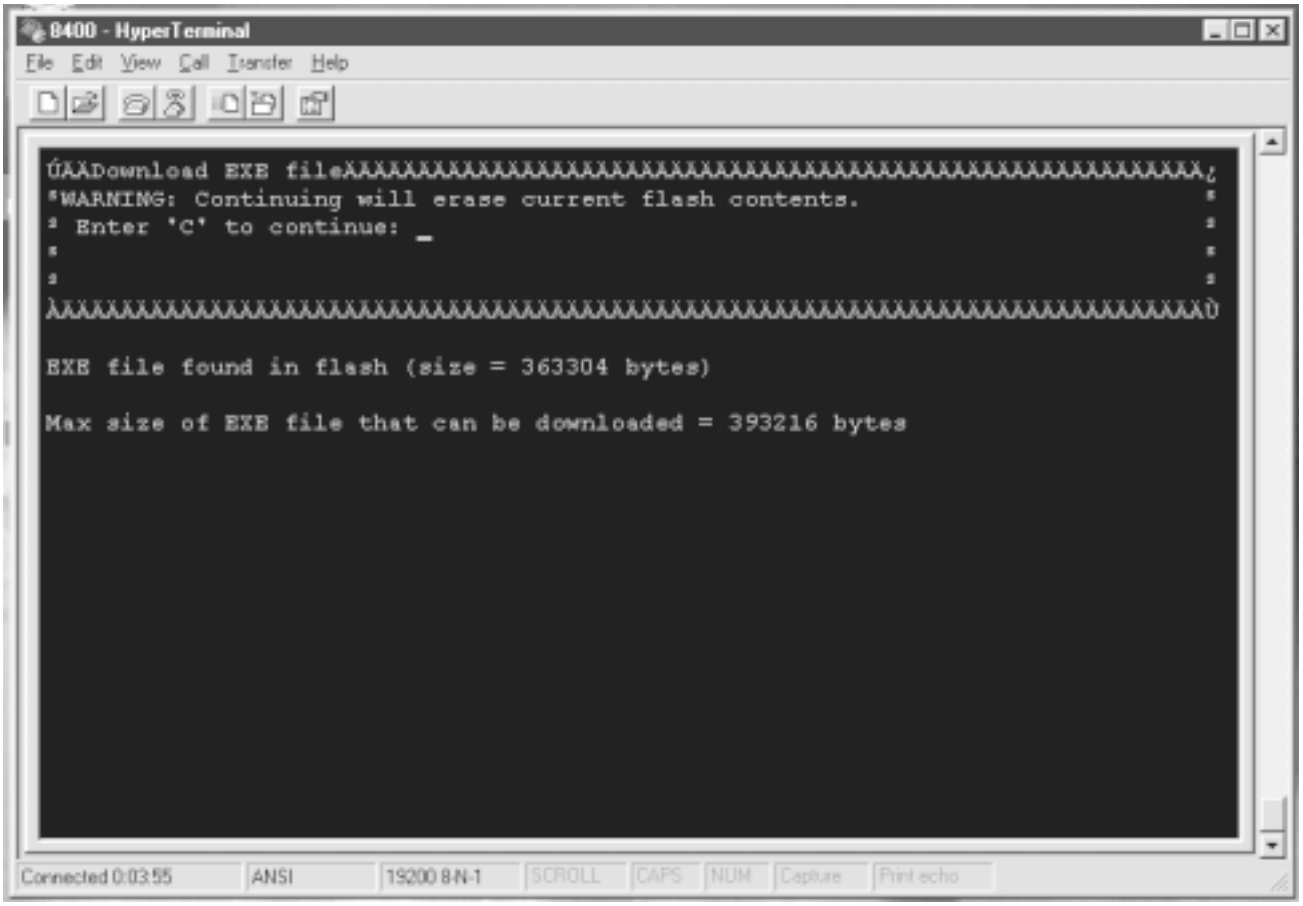
7 *The Main Menu Screen*

The "Main Menu" screen will display on your PC. Press the "E" key on your PC's keyboard to erase the old software program currently loaded in the Pulse Generator.



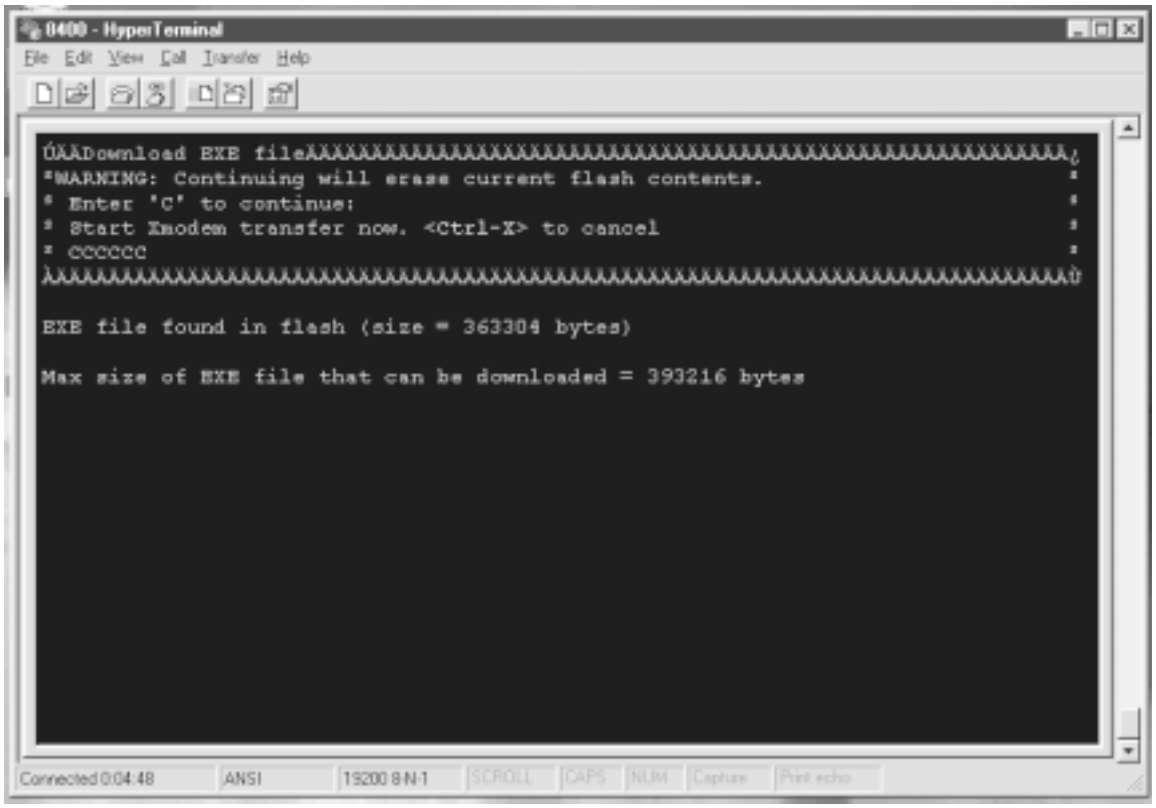
8 *The Download EXE File Screen*

The "Download EXE file" screen will display on your PC.
Press the "C" key on your PC's keyboard.



9 *Transfering the New Software Program*

While in the "Download EXE file" screen, select "Transfer" and "Send File" from your communication software's menu. This will dispay the "Send File" screen.

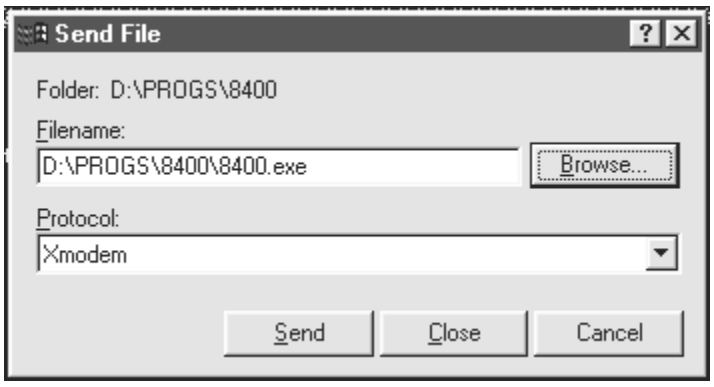


10 *The Send File Screen*

While in the "Send File" screen, ensure that the "Protocol:" field displays "Xmodem."

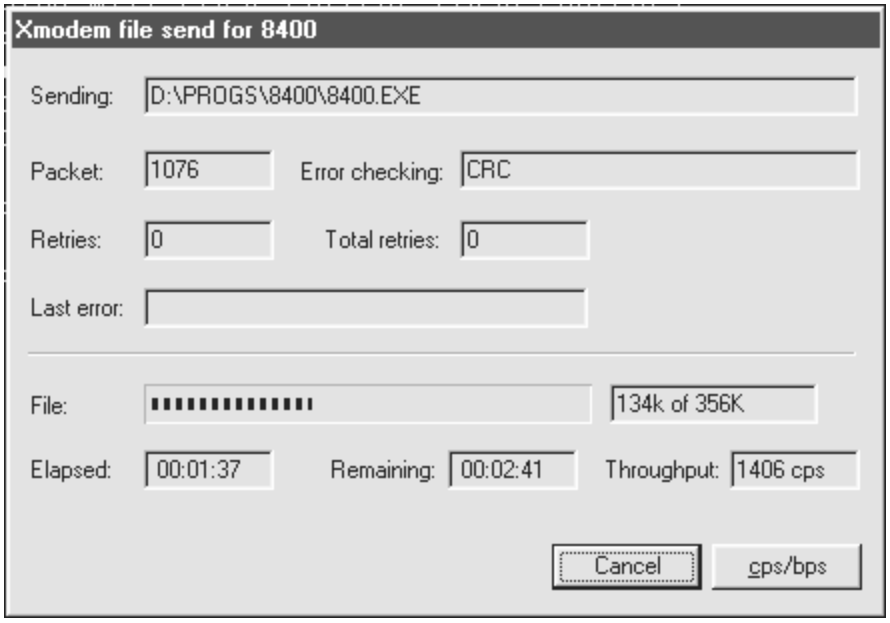
Select the "Browse..." button and go to the location where you stored the program "8400.exe" (the new software program that you downloaded from R&P's website). Click twice on the "8400.exe" file.

The "Send File" screen will reappear with the path to the "8400.exe" file in the "Filename:" field. Select the "Send" button.



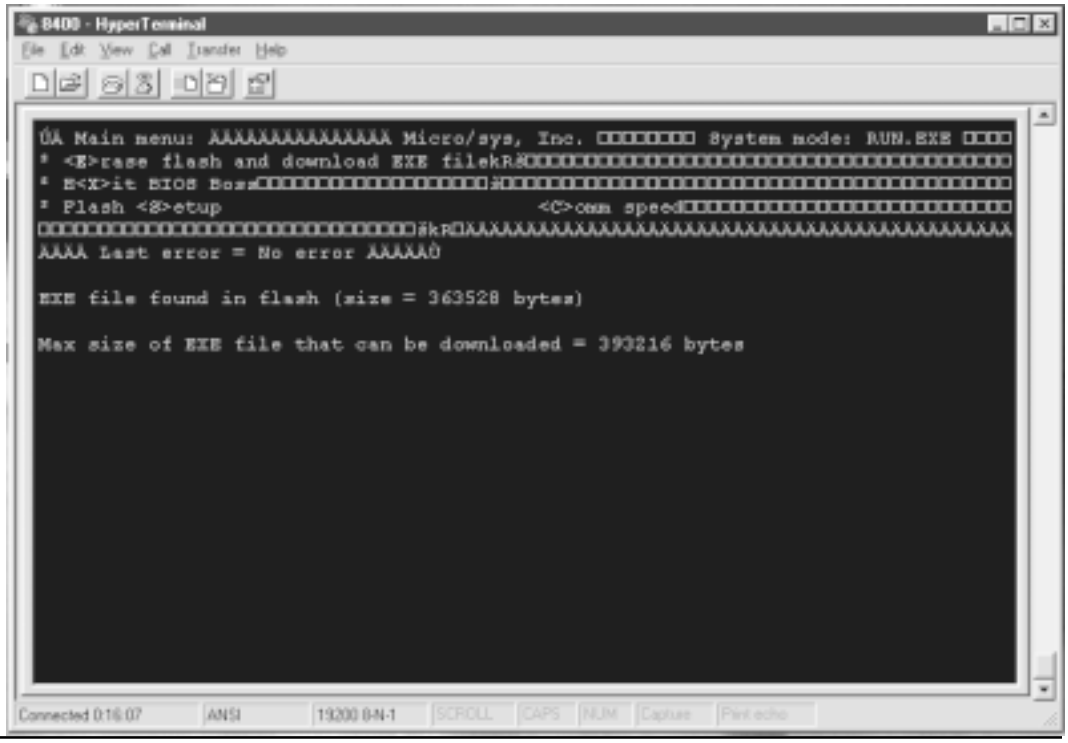
11 *The Xmodem File Send For 8400 Screen*

The "Xmodem file send for 8400" screen will display and indicate the progress of the file transfer.



12 *File Transfer Complete*

When the file transfer is complete, the "Main Menu" screen will reappear. Exit from your communication software application.

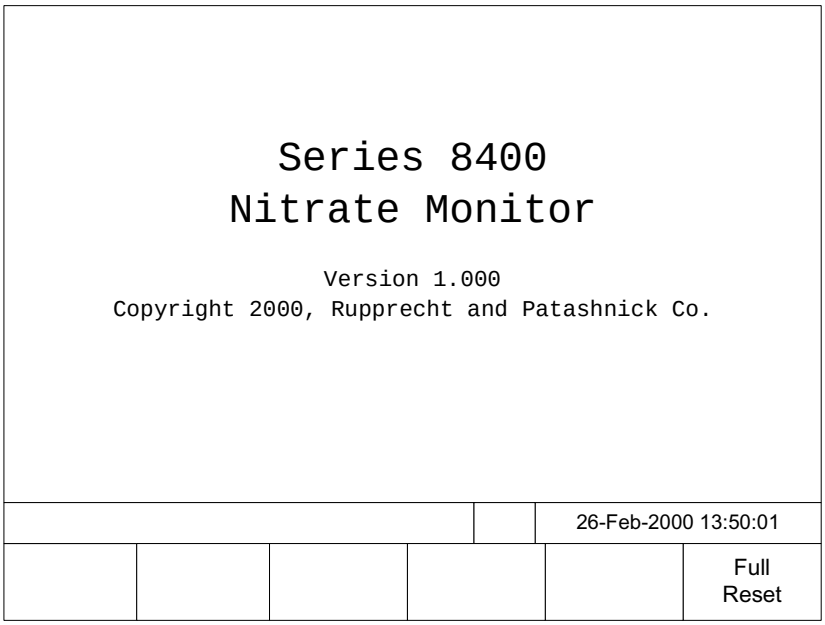


13 *Resetting the Pulse Generator*

Disconnect the 9-to-9 pin computer cable and the 8400 upload adapter.

Turn off the Pulse Generator, wait 10 seconds and then turn it on again.

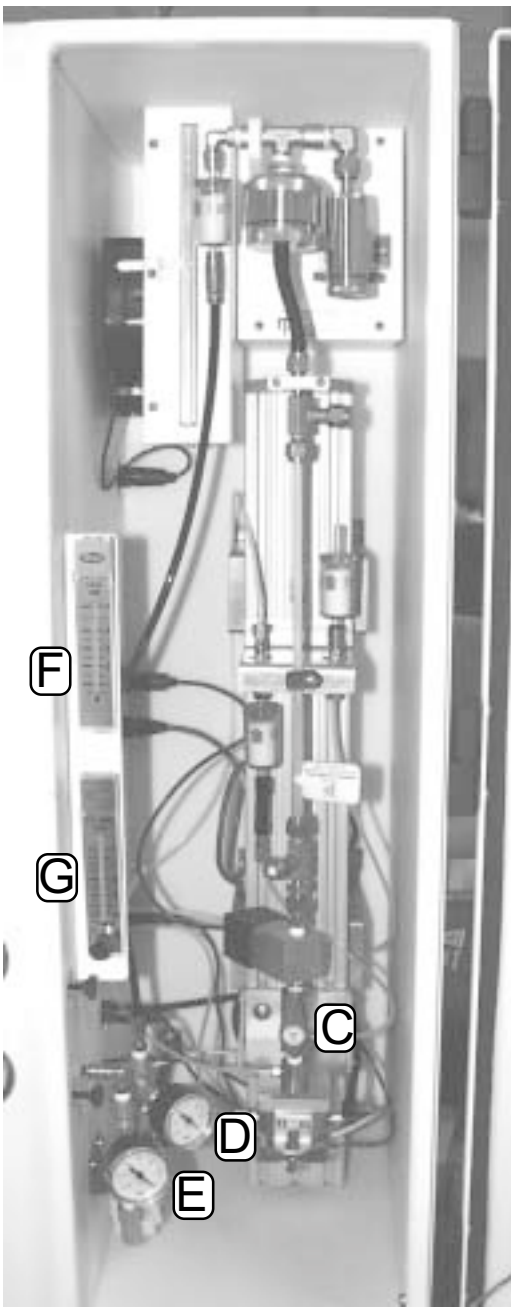
When the Title screen displays on the Pulse Generator's screen, press <F6: Full Reset>. You may now set up the Pulse Generator to run a cycle (Section 2).

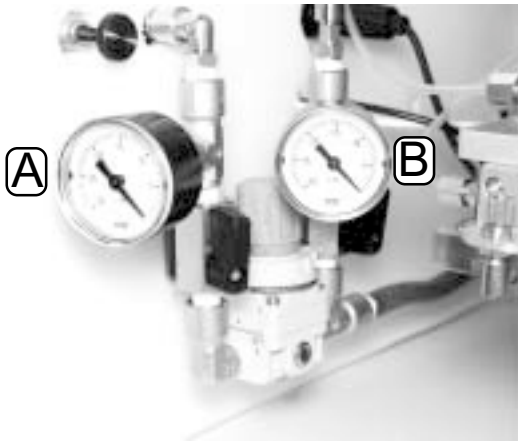


Section 6: Isolating the Leak

This section explains how perform a secondary manual leak check to isolate the leak in the system. You should perform this procedure only after performing the primary manual leak check (Section 1, step 14).

1





Performing a Secondary Manual Leak Check

IMPORTANT: Ensure that the pump is turned on before performing the primary or secondary manual leak check. Perform a primary manual leak check (Section 1, step 14). Check your fittings to ensure that they are secure. Repeat the primary manual leak check. If there are no leaks in the system, open all the valves, return to Section 1 and perform step 15. If there is still a leak in the system, open the makeup flow valve (D). Close the sample valve (C). Allow the rotometers (F and G) to settle. Close the sample/bypass flow valve (E) and the makeup flow valve. Wait 1 minute. Open the sample/bypass flow valve. When you open this valve, watch the cell vacuum gauge (A). If the needle on the gauge moves more than 1 inch, there is a leak in the cell assembly or the manifold valves. Open the makeup flow valve. When you open this valve, watch the makeup flow vacuum gauge (B). If the needle on the gauge moves more than 1 inch, there is a leak in the inlet or makeup flow channel. Tighten the fittings in the section of the instrument where you found the leak. Repeat the secondary manual leak check. If there are no leaks in the system, open all the valves, return to Section 1 and perform step 15. If there is still a leak in the system, call R&P.

Section 7: Replacing Flasher Strips

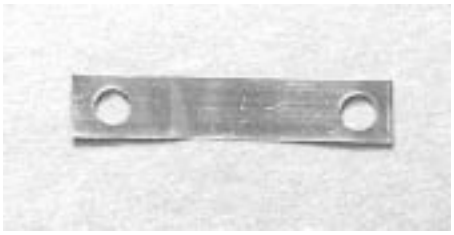
This section explains how replace flasher strips located inside the cell assembly.

1

Removing the Damaged Flasher Strip

Unscrew the knob on the front of the cell assembly and push the tab to the side to open the cell assembly. Pull the bottom of the cell assembly down to display the flasher strip (A). Unscrew the nuts on both posts with the 1/4" drive socket handle and remove the damaged flasher strip.

2



Installing a Flasher Strip

Slide a new flasher strip onto the two posts. **IMPORTANT: The strip should be installed directly on the posts. Do not place the washers under the strip.** Place the washers on top of the strip and the nuts on top of the washers. Tighten the nuts. Be sure to tighten the nuts enough to make contact with the flasher strip. **IMPORTANT: Do not over-tighten the nuts, this will twist and damage the flasher strip.** Push the bottom of the cell assembly up and line the tab up so that it holds the assembly together. Tighten the knob.

Check the cell vacuum (Section 1, step 15).

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Appendix B: Maintenance Log Sheets

R&P 8400N Daily & Weekly Checks

Site:_____ **Instrument SN:**_____

Notes (below & nos. in SOP Sec. 11):			1.					2.		3.			4.	5.
Date:	Time	Operator	N2 Cyl Pressure	Cal Cyl Pressure	Fill Water Bottle	Adjust R-Cell to 5.0	Record orifice flow rotameter during analysis.	Record Audit Data	Span Re-set?	Routine Checks all Yes? (say OK) Note corrective action taken	Note if cell orifice cleaned	Note if flash strip replaced	Note if Semi-monthly checks run	Fax logs to ADI, STI

1. Note each of these:
---N2 and Cal gas cylinder pressures
_ Replace N2 cylinder if <500psi, or will be <100psi before next visit.
If pressure loss excessive, check for leaks
_If cal gas pressure drop excessive, turn off at cylinder and
set to manual audit in cycle configuration (every 0 days)
---Fill water reservoir -- **DO NOT TIGHTEN CAP ! !**
---Check R-Cell (NOx box), adjust to 5.0 if necessary
---Check and record Orifice flow rotameter during analysis
(when current step says purge, baseline or read.)
Should be betw 2 and 5. Note if adjusted.
2. Record and Check analyzer span
---Record analyzer audit data on Anal Audit Sheet
---If last steady state differs from span conc. by more than 10% stop, respan and conduct manual audit (see Analyzer Audit Log). **Note time respanned.**

3. Routine Checks. Check that each of these is true. Note corrective action:
---Pulse analyzer green light next to 'sample' ?
---Pulse generator status light off ?
---Mode=RUN ?
---Water Reservoir OK?
---Flash Strip OK? If no, replace and note above.
---Makeup flow rotameter between 3 and 5?
---Orifice flow rotameter =0 during sample?
---Does front vacuum gauge read between -15 and -17?
---Does back vacuum gauge read < -20?
---0.9<Sample flow<1.1 when in "sample"? If not, clean orifice and note above.
---In general, check that values on data record are within specifications in SOP Table 2.
---If it has rained, check and dry cyclone bottom cup.
4. Note if semi-monthly checks run and complete Semi-montly log sheet.
5. Every week Fax all logsheets to ADI (510) 649-9260 & STI (707) 665-9800

R&P 8400N Semi-Monthly Checks

Site:___________ **Instrument SN:**_______________

		Notes (refer to SOP Sec. 11):	Every second week 6.	7.	8.	Every 4-6 weeks 9.	10.	11.	11.	12.	
Date:	Time	Operator	Run field blank. Note times	Clean cyclone. Note time	Run aqueous standards	Clean cell orifice	Replace flash strip	Check makeup flow filtr	Check analyzer filter	Leak check system	Comments
			fltr on______ rmvd______	time_______							
			fltr on______ rmvd______	time_______							
			fltr on______ rmvd______	time_______							
			fltr on______ rmvd______	time_______							
			fltr on______ rmvd______	time_______							
			fltr on______ rmvd______	time_______							
			fltr on______ rmvd______	time_______							
			fltr on______ rmvd______	time_______							
			fltr on______ rmvd______	time_______							
			fltr on______ rmvd______	time_______							

<u>Date</u> <u>Comments</u>

R&P 8400N Analyzer Audit Data

Site:____________________ **Instrument SN:**________________

See number 2 in SOP Sec. 11 for instructions

Audit Date	Audit Time	Operator	Audit Type	**Respanned before audit?	***Span Gas Concentration	Steady State Check (ppb)	Flow Balance Check (ppb)	Line Purge (ppb)	Nox Pulse Read (ppb*s)
			Auto / Man	Yes / No, If yes Time_______					
			Auto / Man	Yes / No, If yes Time_______					
			Auto / Man	Yes / No, If yes Time_______					
			Auto / Man	Yes / No, If yes Time_______					
			Auto / Man	Yes / No, If yes Time_______					
			Auto / Man	Yes / No, If yes Time_______					
			Auto / Man	Yes / No, If yes Time_______					
			Auto / Man	Yes / No, If yes Time_______					
			Auto / Man	Yes / No, If yes Time_______					
			Auto / Man	Yes / No, If yes Time_______					
			Auto / Man	Yes / No, If yes Time_______					
			Auto / Man	Yes / No, If yes Time_______					
			Auto / Man	Yes / No, If yes Time_______					

*** Span gas concentration in ppb as labeled on bottle. This will always be the same unless you change bottles.

**If last Steady State Check differs from Span Gas Conc by more than 10%, stop system and…

---Record current Audit Data
---Press MENU, go to "Enter Service Mode" and "Analyzer Audit"
---Run a "Line Purge"
---Near end of cycle, press "Zero" then "Enter" in Cal mode on Pulse Analyzer
---Run a "Steady State"
---Near end of cycle, press "Span" then "Enter" in Cal mode on Pulse Analyzer
---Immediately run a "Full Audit"
---Record new Audit Data
---Press escape, select "Exit Service Mode" and return analyzer to "Run" mode

R&P 8400N Aqueous Standards Log

Site:_____ **Instrument SN:**_____

Standards: 300 ng NO_3 from $NaNO_3$ 10/23/2000 *See no. 8 in SOP Sec. 11 for instructions*
18.0 M-Ohm H_2O Blank

Volume Deposited (uL)	Mass Deposited (ng)	Date: Time: Operator: Baseline (ppbs)	Corrected Pulse(ppb*s)	Measured Mass (ng)	Date: Time: Operator: Baseline (ppbs)	Corrected Pulse(ppb*s)	Measured Mass (ng)	Date: Time: Operator: Baseline (ppbs)	Corrected Pulse(ppb*s)	Measured Mass (ng)
0.4	120									
0.4	120									
0.4	120									
0.6	180									
0.6	180									
0.6	180									
0.2	60									
0.2	60									
0.2	60									
0.5 (Blank)	0									
0.5 (Blank)	0									
0.5 (Blank)	0									
0.8	240									
0.8	240									
0.8	240									